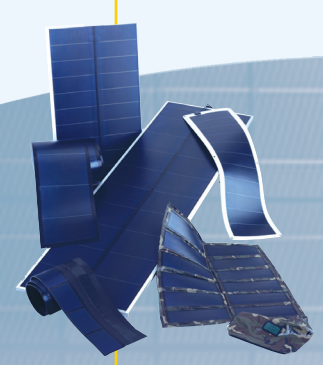


Thin Film PV Partnership

Fulfilling the promise of thin film photovoltaics

The Thin Film PV Partnership spearheads R&D on emerging thin film PV technologies. Led by the National Center for Photovoltaics and NREL, the Partnership leverages the combined efforts of the thin film PV industry, universities, and government research institutes.

The idea of thin films is simple: truly cost-competitive PV devices can be produced by using an extremely thin layer of active semiconductor, the material that actually converts sunlight into electricity. The semiconductor layers on thin film PV cells are only a few millionths of a meter thick and deposited on inexpensive materials such as glass.

The Thin Film PV Partnership has helped reduce costs and improve performance of thin film devices over the past decade, and thin films have recently burst into the marketplace. By 2010, U.S. production of thin film modules is expected to exceed that of crystalline silicon modules. The United States continues to be a world leader in thin film module manufacturing as well. A recent survey by the Partnership indicates the United States will account for almost half of the projected 500 MW of global thin film production capacity in 2008. World thin film production was 85 MW in 2005.

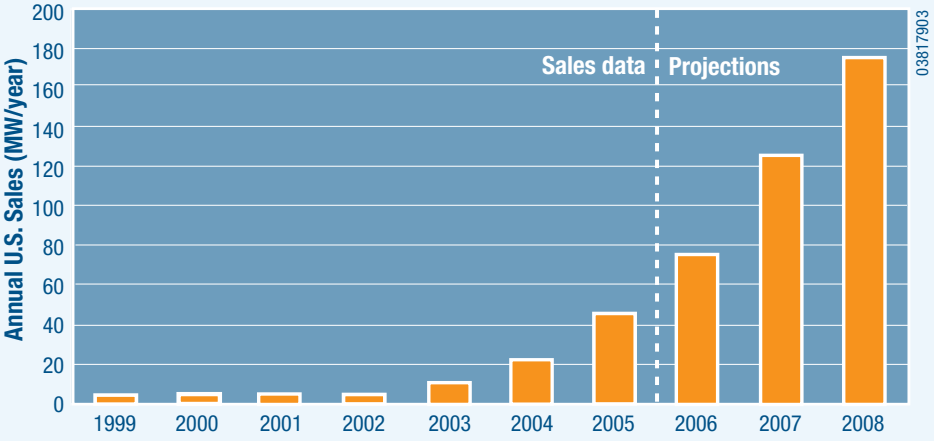
Goals

- Support the near-term transition to first-time manufacturing and commercial introduction of reliable thin film PV modules.
- Build a technology base upon which thin films can continue to improve in terms of manufacturing, performance, reliability, and reduced cost for products competitive in the PV marketplace.
- Sustain innovation to support progress toward ambitious long-term PV cost and performance goals leading to cost-competitive PV electricity.

Recent Thin Film PV Partnership Participants

- Brookhaven National Laboratory
- Case Western University
- Colorado School of Mines
- Colorado State University
- Energy Conversion Devices
- Energy Photovoltaics
- First Solar
- Florida Solar Energy Center
- Global Solar Energy
- International Solar Electric Technologies
- Iowa State University
- ITN Energy Systems
- NanoSolar
- National Institute of Standards and Technology
- National Renewable Energy Laboratory
- Pacific Northwest National Laboratory
- Pennsylvania State University
- Shell Solar Industries
- Syracuse University
- Texas A&M University
- United Solar Ovonic
- University of Delaware, Institute of Energy Conversion
- University of Florida
- University of Illinois
- University of Nevada
- University of North Carolina, Chapel Hill
- University of Oregon
- University of South Florida
- University of Toledo
- University of Utah

Despite the success so far, much R&D remains to be done to make thin films competitive with conventional energy sources. Research areas include improving the fundamental understanding of materials and devices, increasing device efficiency and reliability, and developing manufacturing capabilities for large-scale production. The Thin Film PV Partnership supports these efforts with a focus on amorphous silicon, cadmium telluride, and copper indium diselenide thin films. Following are highlights of several partners working on these technologies.



Historical (through 2005) and projected (2006–2008) U.S. sales of thin film PV modules made in the United States by U.S.-owned companies. Source: NREL.

Amorphous Silicon

United Solar Ovonic (Uni-Solar) manufactures a 136-W "peel-and-stick," flexible, multijunction amorphous silicon (a-Si) thin film module for commercial rooftop applications. Its sales in 2005 were approximately 22 MW. Uni-Solar has also reported achieving a record 15.1%-efficient (active area, initial efficiency) tandem a-Si/nanocrystalline-Si cell. Improving this technology to the point of commercial production is a major focus of Uni-Solar's continuing R&D efforts.

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Uni-Solar "peel-and-stick" a-Si thin film modules in a 300-kW array, Beijing Capital Museum, China.

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President George W. Bush tours Uni-Solar's manufacturing plant in Michigan to highlight his 2006 Solar America Initiative.

Cadmium Telluride

First Solar, LLC is the major Thin Film PV Partnership industry partner focusing on cadmium telluride (CdTe) thin films. The company sold about 20 MW of CdTe PV in 2005 and is planning to increase its production capacity to 100 MW in 2007. In 2003, First Solar and NREL shared an R&D 100 Award for developing an innovative CdTe module manufacturing process.

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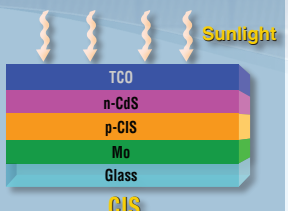
First Solar CdTe thin film modules in a 1.3-MW solar field, Germany.

Copper Indium Diselenide

Shell Solar Industries manufactures thin film modules based on copper indium diselenide (CIS, which is called CIGSS when the elements gallium and sulfur are added). The company has fabricated an 11.7%-efficient, 86-W thin-film CIGSS module, which is entering the European market in 2006. Shell Solar collaborates extensively with NREL and the Partnership's National CIS R&D Team. Among other accomplishments, NREL researchers have fabricated a thin-film CIGS solar cell with a record total-area efficiency of 19.5% using an NREL-patented three-stage process.



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Shell Solar 1.5-kW array composed of 80-W CIS modules undergoing long-term reliability testing at NREL's Outdoor Test Facility.